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## FOUR NEW SPECIES OF FLEAS FROM MEXICO (SIPHONAPTERA)<sup>1</sup>

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Diseases such as sylvatic plague, Bullis fever, and Michoacan fever have stimulated interest in the ectoparasites of Mexican rodents. Surveys connected with the first two diseases have led to the description of two species of fleas subsequently found to be essentially Mexican in distribution (Augustson, 1944; Traub, 1950; Traub and Hoff, 1951). Relatively little is known about the flea fauna of Mexico, as is evident from the fact that the present paper includes the description of two new species of *Strepsylla* Traub, 1950, bringing the total named since 1950 to four.

A new species of *Hystrihopsylla* Taschenberg, 1880, and another of *Monopsyllus* Kolenati, 1857, are also herein described and figured, and the latter is compared with *M. eumolpi* (Rothschild, 1905), *M. fornacis* Jordan, 1937, and *M. eutamiadis* Augustson, 1941.

### ABBREVIATIONS USED IN TEXT AND FIGURES

A.A.R., third aedeagal rod (accessory apodemal rod)  
A.B., antepygidial bristle  
AE.A., aedeagal apodeme  
A.I.T., armature of sclerotized inner tube  
A.M.S., apicomedian sclerite  
AP.A., apical appendage of aedeagal apodeme

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B.I.T., band of sclerotized inner tube of aedeagus  
B.P.W., base of wall of aedeagal pouch  
CR., crochet  
C.S., crescent sclerite of aedeagus  
D.A.L., dorsal anal lobe of proctiger  
D.A.9, distal arm of male ninth sternum  
D.I.R., dorsal intramural rod of aedeagus  
D.L., distodorsal lobe of aedeagus (*Strepsylla*)  
D.L.P., dorsal lobe of proctiger  
F., movable finger or digitoid of clasper  
FL., semi-membranous flap associated with male ninth sternum (*Strepsylla*)  
FL.S., flanking sclerite of aedeagus  
I.R., intramural rod of aedeagus  
LD., lucodisc  
L.L., lateral lobe of aedeagus  
L.M., lateral metanotal area  
L.S., lateral sclerite of apodemal strut of aedeagus  
LU.S., lunate structure in aedeagal pouch  
MB., manubrium  
M.D.L., median dorsal lobe of aedeagus  
MPM., mesepimere  
MPS., mesepisternum  
M.S., median sclerite of apodemal strut of aedeagus  
MSN., mesonotum  
MTM., metepimere  
MTN., metanotum  
MTS., metepisternum  
P., immovable process of clasper  
P.A.9, proximal arm of male ninth sternum  
PL.A., pleural arch of metathorax  
PM., apical plume of male eighth sternum  
PR., process connecting male eighth and ninth sterna  
P.R., penis rod  
P.S., proximal spur of aedeagus  
PS.S., pseudosetae  
P.W., wall of aedeagal pouch  
7S., seventh sternum  
8S., eighth sternum  
9S., ninth sternum  
S.D.L., subapical dorsal lobe of aedeagus (*Strepsylla*)  
S.I.T., sclerotized inner tube of aedeagus  
SN., sensillum  
SP., spermatheca  
SPC., spiracle  
SQ., squamulum  
1T., first tergum  
7T., seventh tergum  
8T., eighth tergum  
9T., ninth tergum

T.AP.9, tergal apodeme of segment 9

V., vesicle of aedeagus

V.A.L., ventral anal lobe of proctiger

V.P., subanal sclerite

# DESCRIPTIONS OF NEW SPECIES

## FAMILY HYSTRICHOPSYLLIDAE

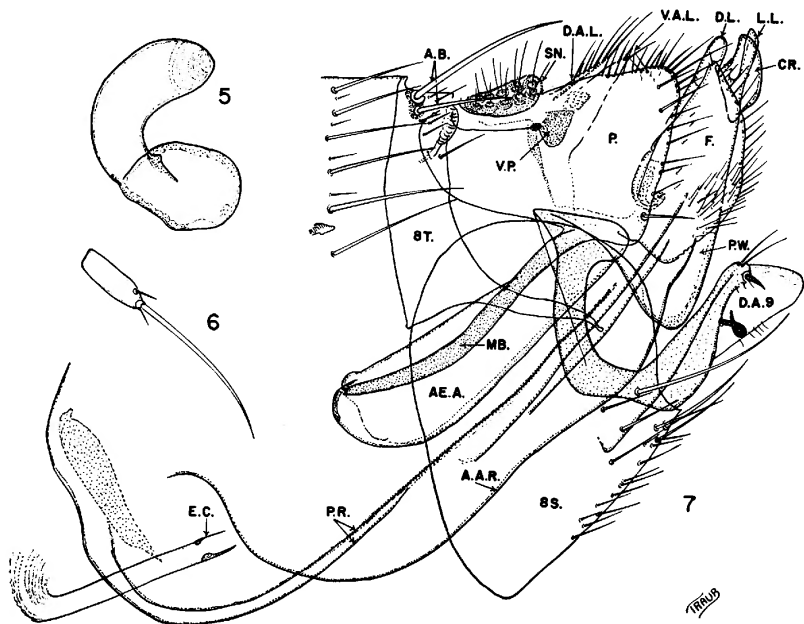
### SUBFAMILY NEOPSYLLINAE

#### *Strepsylla davisae*, new species

Figures 1-4, 7, 11

#### TYPE

Holotype male; *ex Peromyscus* sp.; Mexico, Durango, 5 miles west of El Salto; elevation 8800 feet, July 5, 1951; collected by



FIGS. 5, 6. *Strepsylla taluna*, new species. 5. Spermatheca. 6. Anal stylet.

FIG. 7. *Strepsylla davisae*, new species. Modified abdominal segments, male.

Betty S. Davis. Deposited in the collections of the American Museum of Natural History. (No other specimen known.)

#### DIAGNOSIS

Agrees with *Strepsylla fautini* Traub, 1950, in that the bristles on the caudal margin of the movable finger are relatively short,

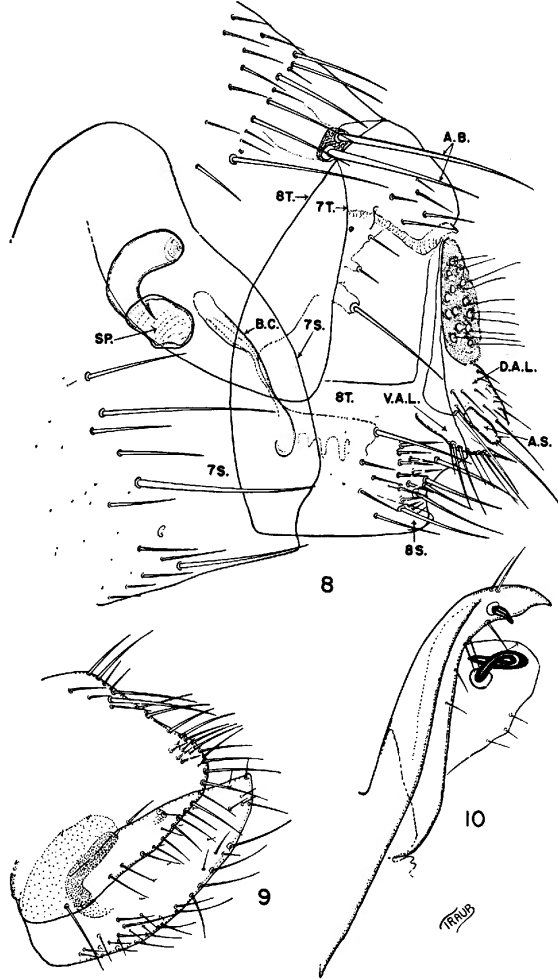
much shorter than the digitoid is broad (in contrast to the genotype, *S. mina* Traub, 1950). Readily separable from *S. fautini* as follows: Distal arm of ninth sternum with ventral (apparently caudal) margin rather convex proximad to insertion of prominent, single-looped, hook-like spiniform on the associated membranous process (fig. 4). In *S. fautini* the distal arm of the ninth sternum is not convex, being more or less of the same width; the spiniform is doubly looped (fig. 11). In the new species the crochet (fig. 11, CR.) is almost as broad as long, apically ovate; not long and narrow, five times as long as broad at maximum, acuminate (fig. 13). Base of wall of aedeagal pouch (fig. 11, B.P.W.) broad and angulate, instead of being straight and relatively narrow (fig. 13, B.P.W.). In the new species the movable finger (fig. 2, F.) has approximately 23 mesal bristles near the ventrocaudal angle, not merely approximately 10.

#### DESCRIPTION

**HEAD, MALE (FIG. 1):** Frontoclypeal margin evenly rounded but with very small but distinct acute median tubercle. First pre-antennal row consisting of six or seven small bristles; second row of four much longer bristles, but of these, that near eye (third bristle) shorter than others of row. Genal ctenidium arising immediately ventrad to reduced eye; mesal spine acuminate, extending somewhat apicad of subrounded, overlapping lateral spine. Genal process with apex just visible caudad to ctenidium. Maxillary lobe extending somewhat beyond apex of third segment of maxillary palpi. Labial palpi five-segmented, extending near to apex of fore trochanter. Scape of antenna with very short proximal and subapical bristles. Second antennal segment with an apical fringe of small bristles, not extending beyond third segment of fairly symmetrical club. Postantennal region with two rows of bristles arranged approximately 4-5; these rows preceded by a fairly long bristle near base of scape.

**THORAX (FIG. 3):** Pronotum with one row of about six large bristles on a side; row with smaller and thinner intercalary bristles somewhat displaced caudad. Pronotal comb with a total of about 12 fairly broad spines. Mesonotum with three rows of bristles; the first row reduced; bristles of last row much larger than the others and with small intercalaries. Mesonotal flange on each side with about two pseudosetae (PS.S.). Mesepisternum (MPS.) with one or two short bristles and one long median one.

Mesepimere (MPM.) with four bristles, that near ventral margin longest. Metanotum with two rows of bristles and a third row indicated by two or three small bristles. Lateral metanotal area (L.M.) well demarcated; a dorsal bristle and two ventral bristles,



FIGS. 8-10. *Strepsylla taluna*, new species. 8. Modified abdominal segments, female. 9. Process and digitoid of clasper. 10. Distal arm of ninth sternum.

that near caudal angle long. Metepisternum (MTS.) with three bristles near posterodorsal angle, one very long. Squamulum short and broad, apically rounded. Pleural arch (PL.A.) strongly convex, well developed. Metepimere with seven to nine bristles arranged 4-3-1.

LEGS: Metacoxa with a short patch of mesal spiniforms at anterior margin of distal fourth. Profemur with about 12 small thin lateral bristles. Longest bristle of tarsus of foreleg is on segment 1; this reaching apex of second segment. Second segment of metatarsus with an apical bristle extending beyond apex of fourth segment. No other bristles on any tarsal segment reach beyond apex of following segment. Measurements (in microns) of tibiae and segments of tarsus (petiolate base deleted):

LEG	TIBIA	TARSAL SEGMENTS				
		I	II	III	IV	V
Pro-	130	50	50	40	35	85
Meso-	240	100	80	50	35	90
Meta-	300	230	140	75	50	90

ABDOMEN: Terga with apical spinelets arranged as follows (total number): 6-9-8-4-2. Typical terga with two rows of bristles; both rows extending slightly below level of somewhat sagittate spiracle. Unmodified terga typically with about three bristles on a side. Ventral antepygidial bristle (fig. 7, A.B.) somewhat more than half as long as upper.

MODIFIED ABDOMINAL SEGMENTS, MALE (FIG.7): Eighth tergum (8T.) about three times as broad as long, extending from near base of antepygidial bristle ventrad to a level well below apex of proximal arm of ninth sternum; with a ventral, tongue-like extension reaching beyond this arm of ninth sternum; with posterior margin arising at level of conspicuous eighth spiracle. Eighth sternum with a ventromarginal row of about 14 bristles on a side, some of these submarginal; those near apex the longest; dorsal margin convex, extending to near base of immovable clasper; posterior margin sinuate, subacute at junction with ventral margin.

Claspers of type typical of genus. Immobile process (P.; and fig. 2) with portion caudad of sensillum slightly broader than long; with a dorsomarginal row of thin bristles and a caudal row of similar but more widely spaced bristles; caudomarginal row extending to large subventral bristle which is probably homologous with acetabular bristle; with a subapical mesal patch of about eight small, thin, curved bristles; with about 10 lateral bristles, most of these subdorsal; dorsal and caudal margins shallowly sinuate. Movable finger or digitoid (F.; and fig. 2) little more than twice as long as broad; apical half of anterior margin fairly straight; caudal margin evenly rounded, but somewhat serrate

ventrally; ventral margin somewhat sinuate. Digitoid with a caudomarginal row of bristles extending from apex to serrations; with a patch of about 23 submedian and submarginal thin bristles on middle third. Manubrium (MB.) very long and narrow,

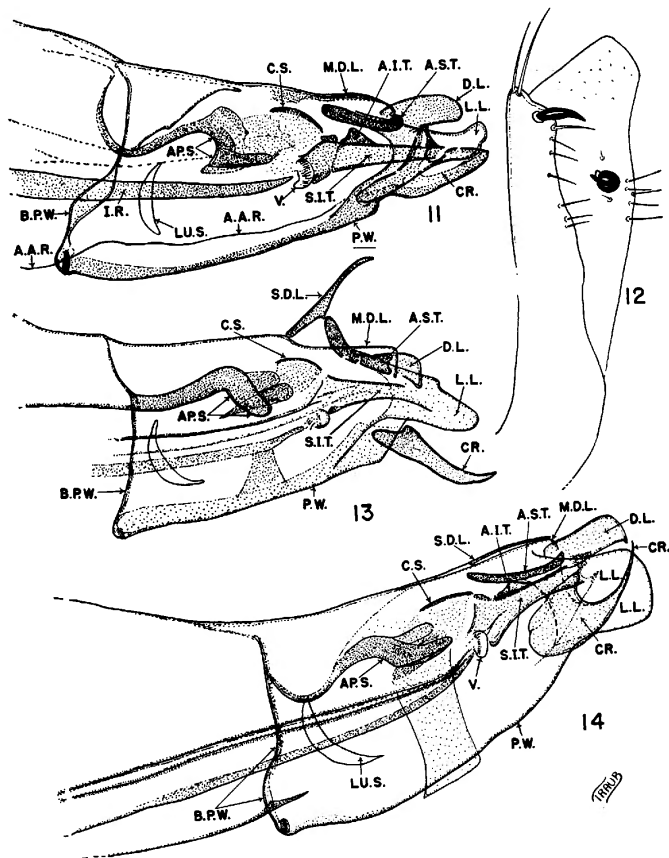


FIG. 11. *Strepsylla davisae*, new species. Apical portion of aedeagus.

FIGS. 12, 13. *Strepsylla fautini* Traub, 1950. 12. Distal arm of ninth sternum. 13. Apical portion of aedeagus.

FIG. 14. *Strepsylla taluna*, new species. Apical portion of aedeagus.

and somewhat sinuate. Ninth sternum with proximal arm with apex expanded; sclerotized portion of anterior margin apically subacute, almost beak-shaped (true apical anterior margin not readily apparent, somewhat obtuse); posterior margin of apical expansion rounded. Distal arm of ninth sternum (D.A. 9; and fig. 4) about as long as proximal arm; clavate but with narrow portion apical; posterior margin becoming pronouncedly convex



below midpoint; apex slightly angled, with two long narrow bristles and a stout sinuate spiniform which is slightly longer than arm is broad at level of insertion of spiniform; with a short stout subapical bristle and two smaller bristles below these; with another thin marginal bristle at apical third, and one or two submedian bristles. The truncate, semi-membranous flap (FL.) associated with ninth sternum about twice as broad as sternum; spiculose apically; with seven thin bristles near middle of caudal margin; with a prominent, single-looped large spiniform inserted near caudal margin of distal arm, above midpoint; with a short thin bristle above and another below looped spiniform.

**AEDEAGUS:** Aedeagal apodeme (AE.A., fig. 7) more than four times as long as broad. Cephalic end somewhat rounded; slightly narrowed caudally. Aedeagus proper almost as long as apodeme. Base of very well-developed pouch wall (fig. 11, B.P.W.) sclerotized, somewhat sinuate and projecting cephalad. Ventral margin of wall of aedeagal pouch (P.W.) well sclerotized. Median dorsal lobe (M.D.L.) shallowly sinuate, terminating at apex of rod-like sclerite (A.S.T.) dorsad of base of sclerotized inner tube (S.I.T.). Subapical dorsal lobe apparently not differentiated (cf. Traub, 1950, pl. 46, fig. 4, S.D.L.). Distodorsal lobe (D.L.) well developed, ovate, and arising from apex of A.S.T. Lateral lobes (L.L.) conspicuous, each produced into a long process extending well beyond apex of sclerotized inner tube; narrowed subapically and apically dilated and somewhat upturned; apical margin with a subventral small sinus. Crochets (CR.) conspicuous, almost twice as long as broad; with proximal portion somewhat narrower than subovate apical portion; with a dorsal wing extending to upper margin of lateral lobe and bearing a distinct subapical acuminate spur. Sclerotized inner tube (S.I.T.) with a proximal, dorsal, triangular sclerotization representing armature of inner tube (A.I.T.). Crescent sclerite (C.S.) well developed. Lobes of apodemal strut (AP.S.) not clearly differentiated. Ventral intramural rod (I.R.) of endophallus distinct; terminating in a weakly sclerotized vesicle (V.). With a semi-membranous lunate structure (LU.S.) near base of aedeagal pouch at level of I.R. and of unknown homology. Penis rods (P.R.) uncoiled. Third aedeagal apodemal rod (A.A.R.) fairly well sclerotized.

Tenth abdominal segment with dorsal lobe of proctiger (fig. 7, D.A.L.) bearing a dorsomarginal fringe of thin bristles. Ventral lobe of proctiger similar but with apical bristles. Subanal sclerite

(= proximoventral sclerite of proctiger) (V.P.) well developed and bearing a relatively large, semi-membranous, dorsal, filamentous tuft.

#### REMARKS

The species is named for Mrs. Betty S. Davis, whose collection of Mexican ectoparasites contained some particularly interesting forms, and to whom we are indebted.

#### ***Strepsylla taluna*, new species**

Figures 5, 6, 8-10, 14

#### TYPES

Holotype male; *ex Neotomodon alstoni*; Mexico, Morelos, 3 miles north of Tres Cumfres Marios; August 17, 1950; collected by G. W. Wharton. Allotype female; *ex Reithrodontomys megalotis*, *ibid.* Deposited in the collections of the American Museum of Natural History. (No other specimens known.)

#### DIAGNOSIS

Agrees with *S. fautini* Traub, 1950, and *S. davisae*, new species, in that the marginal bristles on the digitoid are relatively small; distinctive in that the lateral lobes of the aedeagus (fig. 14, L.L.) are very broad and subtruncate apically, being twice as broad as distodorsal lobes (D.L.) instead of being nearly equal in breadth (figs. 13, 11, L.L., D.L.). Crochets (fig. 14, CR.) talon-shaped as in *S. mina* Traub, 1950, but apically more acuminate. Further separable from *S. davisae* by the distal arm of the ninth sternum (fig. 10) lacking the definite convexity below level of twisted spiniform (cf. fig. 4); subapical spiniform shorter, proximad of apex by a distance definitely greater than length of spine. Female separable from that of *S. mina* (the only other species for which the female is known) by possessing only two antepygial bristles, not three.

#### DESCRIPTION

(Only pertinent differences from *S. davisae* are listed.) Frontal tubercle reduced, scarcely extending beyond head margin. Labial palpi extending to apex of procoxae. Measurements (in microns) of tibiae (petiolate base deleted) are as follows:

LEG	TIBIA	TARSAL SEGMENTS				
		I	II	III	IV	V
Pro-	120	50	45	40	33	70
Meso-	180	90	75	45	33	70
Meta-	240	155	110	70	40	80

Terga with apical spinelets arranged as follows (total number): male, 2-7-7-4-0; female, 6-7-5-4-0. Ventral antepygidial bristle in female (fig. 8, A.B.) about four-fifths of length of upper.

MODIFIED ABDOMINAL SEGMENTS, MALE: Immovable process of clasper (fig. 9) apparently with only about six non-marginal bristles, most of these subdorsal, near sensillum. Movable finger, or digitoid, about two to two and one-half times as long as broad. (Note that in this group of fleas, the breadth of F. may apparently vary, owing to position in mounting.) Digitoid with caudal margin fairly even, lacking distinct proximal serrations; with a group of 10 to 12 submarginal bristles in this area. Proximal arm of ninth sternum with anterior margin straight, not produced into an apical beak. Distal arm of ninth sternum (fig. 10) gradually and evenly narrowing from base to apex; with a subapical spiniform which is fairly short and inserted at a distance from the apex which is equal to about twice its length. Semi-membranous flap associated with ninth sternum lacking a spiculose area; with about three thin bristles near middle of caudal margin.

AEDEAGUS (FIG. 14): Subapical dorsal lobe (S.D.L.) apparently present. Distodorsal lobe (D.L.) about twice as long as broad, apically truncate. Lateral lobe (L.L.) very broad apically, about as broad as distodorsal lobe is long; caudal margin fairly straight; dorsal and ventral margins subapically almost parallel. Crochets talon-shaped, the curve of talon almost twice the length of broad base; apically acuminate. Armature of inner tube reduced to a fairly flat dorsal sclerite above base of sclerotized inner tube.

MODIFIED ABDOMINAL SEGMENTS, FEMALE (FIG. 8): Seventh sternum with a shallow, fairly broad sinus near ventral margin; with a row of about six long bristles, preceded by about five smaller bristles and about three or four ventromarginal small bristles. Eighth tergum (8T.) with a group of about five bristles above long thin spiracle; this group extending ventrad as a row of two small bristles and a median very long bristle at level of dorsal anal lobe; ventrocaudal region of eighth tergum with bristles as follows: four long bristles bordering subventral sinus; with a submedian bristle; below these three or four small lateral bristles; between

these last two groups of bristles a patch of about 10 small, fairly thick mesal bristles.

Eighth sternum (8S.) represented as a conical structure bearing two or three tiny subapical bristles. Dorsal anal

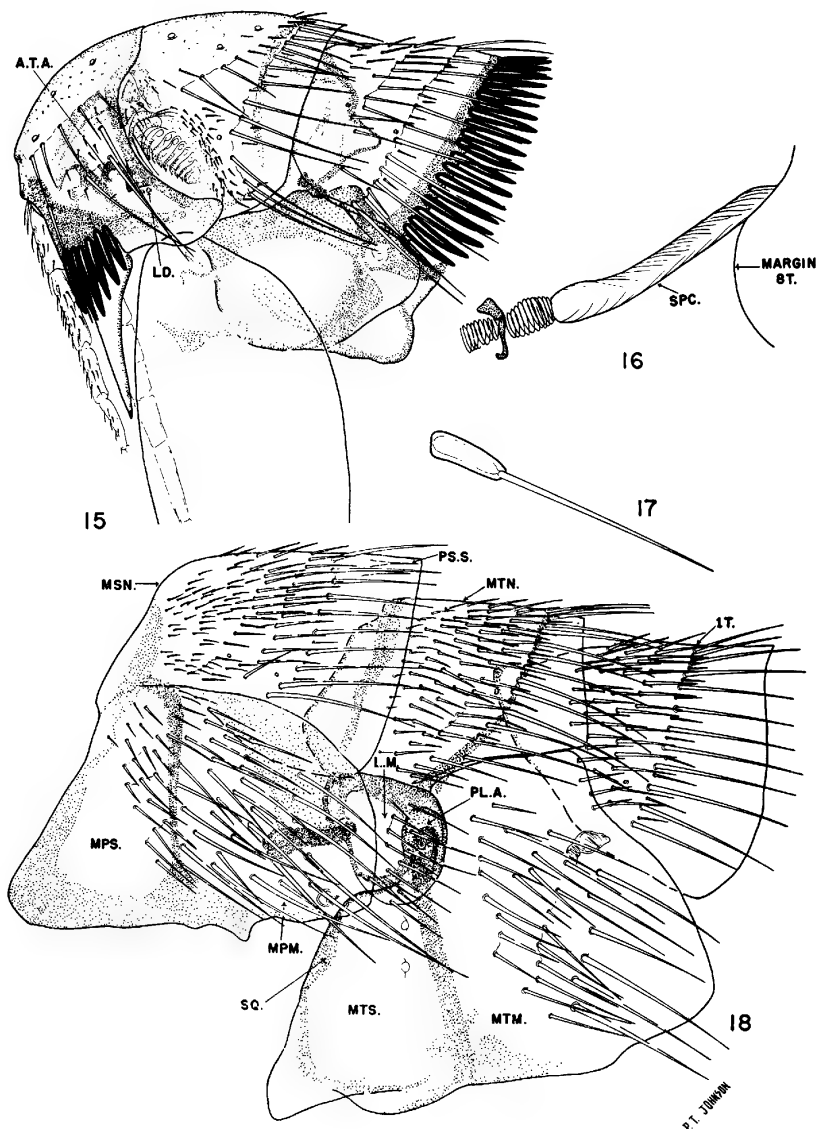


FIG. 15. *Hystrichopsylla kris*, new species. Head and prothorax, female.  
 FIG. 16. *Hystrichopsylla dippiei* Rothschild, 1902. Spiracle of eighth tergum.  
 FIGS. 17, 18. *Hystrichopsylla kris*, new species. 17. Anal stylet. 18. Mesothorax, metathorax, and first abdominal tergum.

lobe of proctiger with a dorsomarginal fringe of small bristles and about 12 scattered bristles, of which the ventromarginal subapical one is long, as is one bristle inserted at base of anal stylet. Ventral anal lobe (V.A.L.) not heavily sclerotized nor angulate; with about seven fairly evenly spaced marginal bristles, four of which are long. Anal stylet (A.S.; and fig. 6) almost three times as long as broad; with a small dorsomarginal bristle and two apical bristles, one of which is very short. Spermatheca (SP.; and fig. 5) with tail longer than head; tail gently upturned, head longer than broad. Bursa copulatrix (B.C.) fairly well developed, with apex (that portion adjoining spermathecal duct) relatively weakly sclerotized.

#### COMMENT ON THE GENUS *STREPSYLLA*

The genus *Strepsylla* is apparently widespread throughout much of Mexico and seems to be a characteristic parasite of indigenous mice and rats. As pointed out in the original description, the genus is near *Meringis* Jordan, 1937, and its allies. *Strepsylla* parallels *Meringis* in that the species exhibit modifications of the ninth sternum and the aedeagus, while the claspers are not nearly so plastic insofar as structural changes are concerned, unlike most genera of fleas.

#### SUBFAMILY HYSTRICHOPSYLLINAE

##### ***Hystrichopsylla kris*, new species**

Figures 15, 17-20

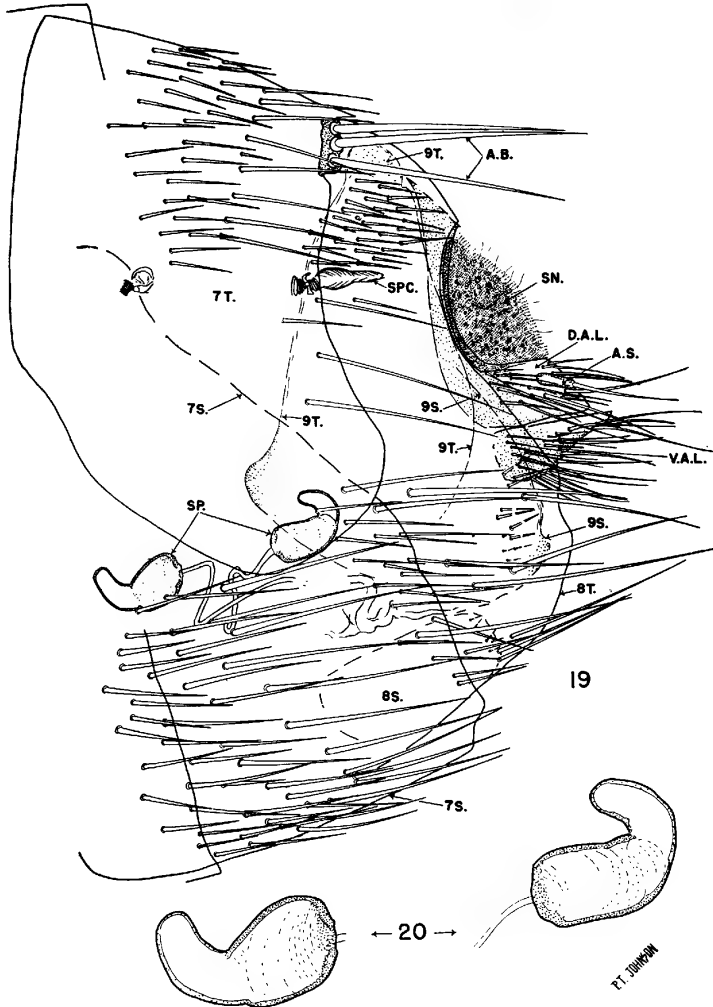
##### TYPE

Holotype female; *ex Neotomodon alstoni*, Mexico, Michoacan: Mt. Tancitaro, July 23, 1941; collected by the senior author when with the Fourth Hoogstraal Biological Expedition. Male unknown. Type deposited in the collections of the Chicago Natural History Museum.

##### DIAGNOSIS

Immediately separable from *Hystrichopsylla dippiei* Rothschild, 1902, and *H. occidentalis* Holland, 1949, by its very large size (about 8 mm.), which suggests *Hystrichopsylla schefferi* Chapin, 1919, but separable in the female from this and other species of

North American *Hystrichopsylla* by the shape of the spiracle of the eighth tergum (fig. 19, SPC.), which is somewhat dagger-shaped, being slightly inflated near closure, tapering to rounded point at apex, not reaching the posterior margin of the eighth tergum, and



FIGS. 19, 20. *Hystrichopsylla kris*, new species. 19. Modified abdominal segments, female. 20. Spermathecae.

removed from the posterior margin of the eighth tergum by a distance of more than half of its length. In other North American species (fig. 16), the spiracle is not narrowed apically and is contiguous with the posterior margin of the eighth tergum or sepa-

rated from it by a distance of much less than half of its length. Further separable from *H. dippiei* and *H. schefferi* by patch of 29 to 30 bristles above spiracle of eighth tergum, instead of 15 to 20; and below spiracle to level of ventral anal lobe with five or six bristles, not 10 to 20 as in other western species (*H. tahavviana* Jordan, 1929, has approximately eight). With only two rows of bristles on postantennal region, not three.

#### DESCRIPTION

HEAD, FEMALE (FIG. 15): Frontoclypeal margin evenly rounded above; pale, indistinct, frontal tubercle inserted at level of base of premental sclerite; margin straight ventrad of tubercle. Pre-antennal area with many scattered small hairs; two rows of bristles; upper of four or five long slender bristles, lower with three stouter bristles; one long bristle inserted on anterior margin of antennal groove between rows. Anterior tentorial arm (A.T.A.) well defined, forming arc above vestigial eye. Two lucodiscs (LD.) present directly below eye. Genal comb of six spines on a side. Maxillary lobe acuminate, extending beyond apex of third segment of maxillary palpus. Labial palpus of four segments, extending slightly more than one-half of length of procoxa. Genal lobe with anterior margin extending more than half of length of most posterior genal spine; with sinuate, horizontal, ventral margin. First antennal segment with a few small hairs basally; two or three longer hairs subapically. Second antennal segment with an apical row of bristles ending far short of apex of club. Posterior margin of antennal groove lined with numerous small bristles. Postantennal area with two complete rows of bristles, plus one or two anterior and dorsal to first row; anterior row of eight to nine bristles, posterior row of about 15, extending from posteroventral margin of antennal groove to dorsal margin of head, longest ventral bristles extending almost entire length of pronotum.

THORAX (FIG. 18): Pronotum with comb of 21 spines on a side; a few anterior small bristles and two and one-half rows of bristles, those of last row extending distad of apex of spines of comb. Mesonotum (MSN.) with about seven rows of bristles, first four rows with small irregular bristles; two or three subdorsal pseudosetae (PS.S.) on each side mesad to flange. Mesepisternum (MP.S.) with about 20 rather short bristles on posterior half. Mesepisternum (MPM.) with 40 or more bristles, more posterior of these longer. Metanotum (MTN.) with about six rows of bris-

ties. Lateral metanotal area (L.M.) large, covering pleural arch, and with two rows of bristles arranged 4-6(7) and one or two bristles anterior to rows. Pleural arch (P.L.A.) present, small. Metepisternum (MTS.) with two bristles (missing from both sides of holotype, but apparently very large) and a keel-shaped squamulum (SQ.) on anterior margin. Metepimere (MTM.) with four irregular rows of bristles arranged 8(9)-4-8(7); those of posterior row longest; plus one or two long bristles among first to third rows.

LEGS: Procoxa with many marginal and lateral bristles. Mescocoxae and metacoxae with bristles confined to anterior margin and laterally to anteroventral surface; and thin mesal bristles scattered from near base to apex near anterior margin. Profemur with dorsomarginal row of bristles; many lateral bristles; two large dorso-apical bristles unequal in length and two or three ventromarginal subapical bristles. Mesofemora and metafemora like profemur except with dorsal portion lacking bristles from base to beyond middle. Tibiae with long heavy bristles inserted on dorsal margin, longest bristles on protibiae and mesotibiae extending beyond apex of first tarsal segment; metatibia with long dorso-marginal bristles (excluding apical four) inserted in notches as follows: 2-2(1)-3-3-3-2-3 (missing on one side). Fifth segment of each tarsus with five lateral plantar bristles. Measurements of tibiae and tarsi of holotype (excluding petiolate base) shown in microns:

LEG	TIBIA	TARSAL SEGMENTS				
		I	II	III	IV	V
Pro-	618	340	206	124	93	196
Meso-	927	579	309	165	113	206
Meta-	1391	989	762	402	216	247

ABDOMEN: First tergum (fig. 18, 1T.) with six rows of bristles. Typical abdominal terga with four complete and two incomplete rows of bristles; apical spinelets on terga 2 to 4, per side, as follows: 8-8(5)-3(4); spinelets ending at about level of spiracle and beginning far below dorsal margin. Basal abdominal sternum with about 10 ventromarginal bristles and a posteroventral row of two or three longer bristles. Typical abdominal sterna with two posteroventral rows of about seven bristles each, and several scattered ventromarginal bristles anterior to rows. Three subequal antepygial bristles.

MODIFIED ABDOMINAL SEGMENTS (FIG. 19): Seventh sternum



(7S.) with convex, slightly irregular posterior margin; with a small projection ventrally on one side and deep broken sinus on other; with a posterior irregular row of 10 to 12 long bristles and about 40 long bristles preceding this row. Eighth tergum (8T.) very large, extending from base of sensillum (SN.) to below small eighth sternum, with group of about 30 small bristles above spiracle; spiracle (SPC.) dagger-shaped, with slightly expanded base; row of five or six bristles ventral to spiracle and ending at level of ventral anal lobe; group of about 24 bristles lateromedially, four long bristles submarginally and about 14 submarginal mesal bristles. Eighth sternum with a few small marginal bristles. Ninth tergum (9T.) very large, well defined, extending ventrally to level of genital opening; portion of anterior margin quite dark; dorsal portion with many small spicules. Ninth sternum (9S.) without bristles, some spicules on ventrocaudal portion. Dorsal anal lobe of proctiger (D.A.L.) with many rather long bristles; anal stylet (A.S.; and fig. 17) four times as long as broad, set dorsally on D.A.L., with long apical bristle and one very small ventro-apical hair (missing on one side). Ventral anal lobe (V.A.L.) clothed with bristles; two bristles at apex longer than others. Paired spermathecae (SP.; and fig. 20) barrel-shaped, slightly wider apically, subequal in size; tail about one-half as wide as head, shorter than head, fairly broad proximally.

#### COMMENT

The dagger-shaped eighth spiracle characteristic of this species is suggestive of the Malay *kris*, hence the name.

#### FAMILY CERATOPHYLLIDAE

#### SUBFAMILY CERATOPHYLLINAE

#### ***Monopsyllus polumus*, new species**

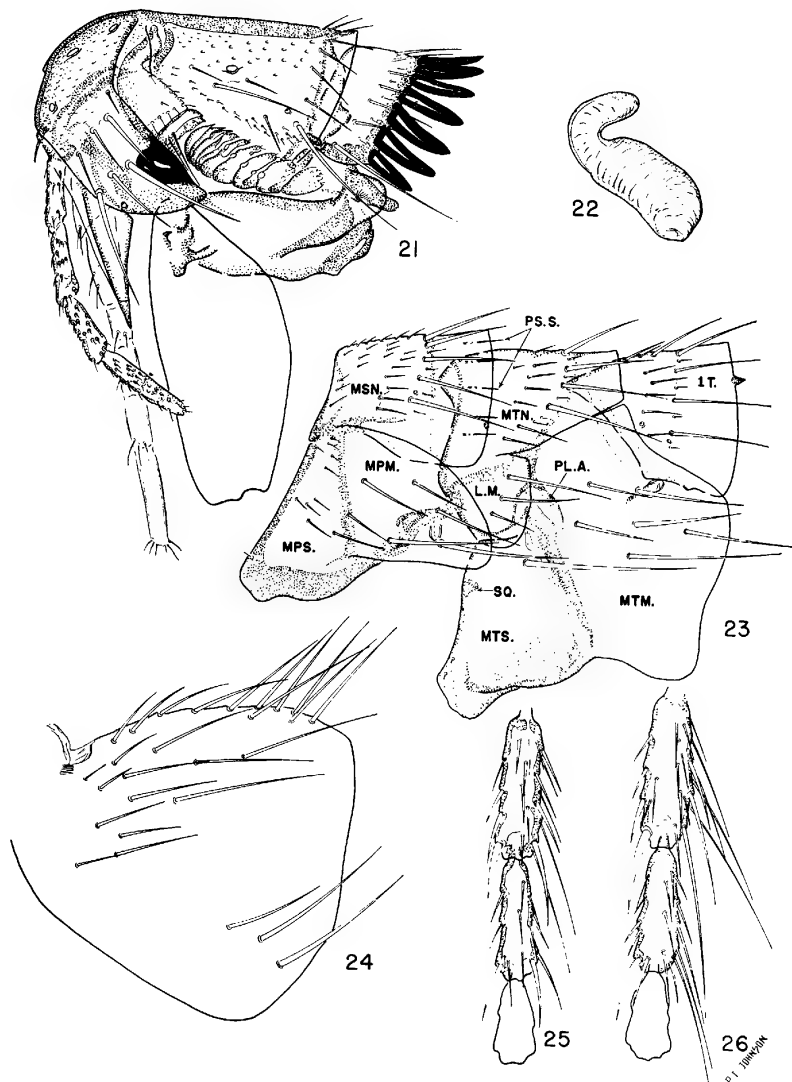
Figures 21-23, 25, 27, 29, 33-35, 40, 45

#### TYPES

Holotype male; *ex* "a sciurid," Mexico, Durango: San Juan 5 miles west of El Salto; July 8, 1951; collected by Betty S. Davis. Allotype female *ibid.* but *ex Eutamias* sp., July 3, 1951. Types deposited in the American Museum of Natural History.

## DIAGNOSIS

This species can be separated in the male from *Monopsyllus eumolpi* (Rothschild, 1905) and the related *M. fornacis* Jordan, 1937, and *M. eutamiadis* Augustson, 1941, by the absence of



FIGS. 21-23. *Monopsyllus polumus*, new species. 21. Head and prothorax, male. 22. Spermatheca. 23. Mesothorax, metathorax, and first abdominal tergum.

FIG. 24. *Monopsyllus eutamiadis* Augustson, 1941. Eighth tergum, male.

FIGS. 25, 26. First two segments of mesotibiae. 25. *Monopsyllus polumus*, new species. 26. *Monopsyllus eumolpi* (Rothschild, 1905).

several long thin dorsal bristles on the first two segments of the mid-tarsi (fig. 25) instead of these segments bearing several long thin bristles extending to the apex of the third tarsal segment (fig. 26). Separable in the female by the shape of the posterior margin of the seventh sternum (fig. 33, 7S.), which is shallowly sinuate and lacks a distinct dorsal lobe (cf. figs. 51, 52, 53A, B, C, and D). In the male the new species can be further separated from *eumolpi* ssp. in that the apical appendage of the aedeagal apodeme (fig. 27, AP.A) is very short instead of being conspicuous, as long as end chamber (fig. 28, AP.A); the distal arm of the ninth sternum (figs. 27, 45, D.A.9) bears on its mediocaudal lobe a proximal patch of very dense bristles, not eight to 10 relatively widely spaced bristles (fig. 44); the juncture of the median dorsal lobe of the aedeagus (fig. 35, M.D.L.) and the aedeagal apodeme is not sharply angled, and the band of the inner tube (fig. 35, B.I.T.) is long and well sclerotized, not short and semi-membranous (fig. 36, B.I.T.). In the female, *M. polumus* can be further distinguished from *eumolpi* ssp. in that the bursa copulatrix (fig. 40) is short, not very long and coiled (fig. 38).

#### DESCRIPTION

HEAD, MALE (FIG. 21): Much as in other members of the genus. Frontal tubercle distinct; five-segmented labial palpi extending well beyond apex of procoxae, but not reaching apex of trochanters (in female just reaching apex of trochanter). Two rows of bristles on pre-antennal region, upper of three medium-sized bristles, lower of three much longer bristles; in addition to these, two short bristles on anterior margin of antennal groove. Second segment of antenna with two or three apical bristles extending nearly one-half of length of club in male; in female with about four distal bristles reaching apex of club. Postantennal region with first two rows represented by but one or two bristles near antennal fossa; third row complete; with a row of small hairs along antennal groove.

THORAX (FIG. 23): Pronotum with one row of bristles. Mesonotum (MSN.) and metanotum (MTN.) with two complete rows of bristles, some small bristles anterior to row on mesonotum. Mesonotum with four or five pseudosetae (PS.S.) on each side. Mesepisternum (MPS.) with four or five small bristles and one or two long ones. Mesepimere (MPM.) with five bristles, postero-

ventral one being long. Metepisternum (MTS.) with small rounded squamulum (SQ.) and one long bristle. Metepimere (MTM.) with three rows of bristles arranged 2-3-1. Lateral

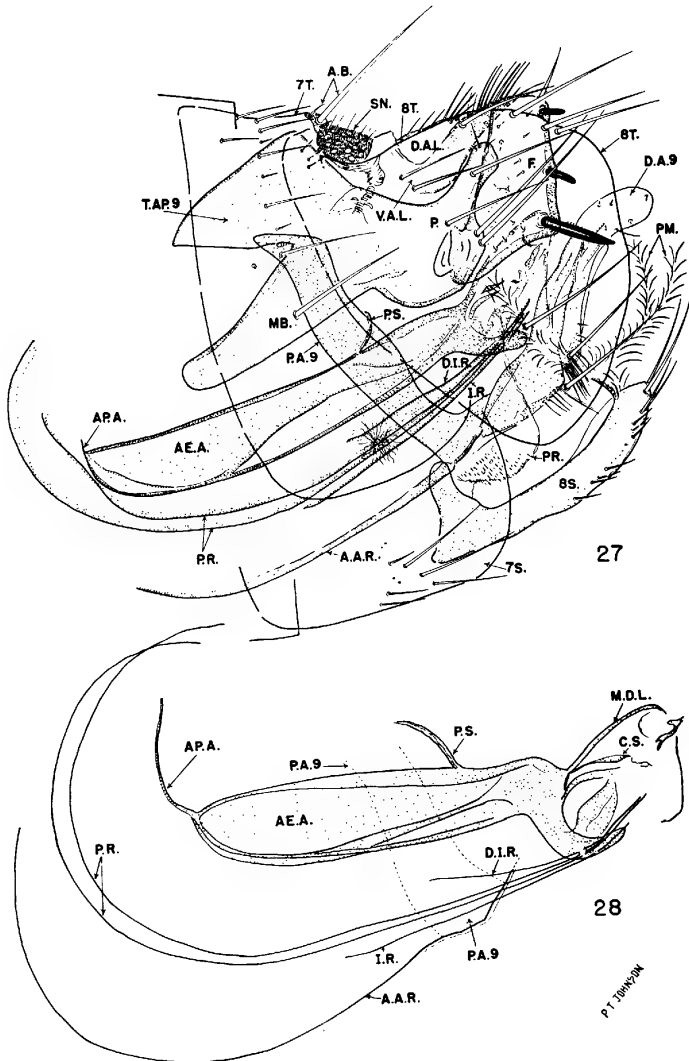


FIG. 27. *Monopsyllus polumus*, new species. Modified abdominal segments, male.

FIG. 28. *Monopsyllus eumolpi* (Rothschild, 1905). Aedeagus.

metanotal area (L.M) about as high as long, upper margin divided from mesonotum only towards apex, bearing three bristles, upper one long. Pleural arch (PL.A) distinct.

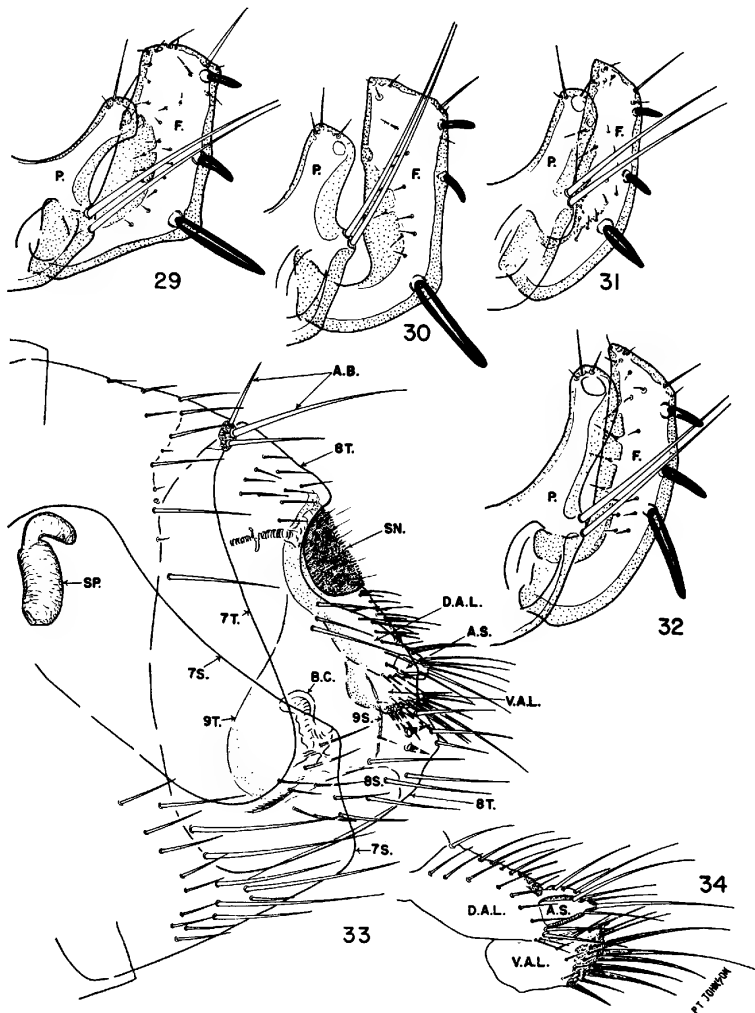
LEGS: First and second tibiae with some bristles extending beyond apex of first tarsal segment. In male only, first mid-tarsal segment with only one long, thin bristle reaching beyond base of third tarsal segment and no bristles of second tarsal segment reaching apex of third (fig. 25), though some dorso-marginal bristles are longer than in such forms as *M. ciliatus* (Baker, 1904) and *M. wagneri* (Baker, 1904). Measurements of tibiae and segments of tarsi of holotype (petiolate base deleted) shown in microns:

LEG	TIBIA	TARSAL SEGMENTS				
		I	II	III	IV	V
Pro-	185	72	72	62	41	113
Meso-	309	134	113	72	41	103
Meta-	412	278	185	113	62	124

ABDOMEN: Terga 1 through 5 with apical spielets. First abdominal tergum (fig. 23, 1T.) with two rows of bristles, plus some smaller anterodorsal bristles. Terga 2 to 7 with two rows of bristles, anterior row short (longer in female), posterior row reaching to or slightly below level of spiracle. Basal abdominal sternum with one subapical bristle ventrally and very small anteroventral bristle. Typical sterna with row of three or four ventral subapical bristles in male; four or five in female. Male with one long antepygidial bristle flanked by two minute bristles; female with three, middle longest, others about one-half of length of middle bristle.

MODIFIED ABDOMINAL SEGMENTS, MALE (FIG. 27): Eighth tergum (8T.) with four or five dorsomarginal bristles; four or five lateral bristles on upper half and two or three lateral bristles on lower half. Eighth sternum (8S.; and fig. 45) of general *Monopsyllus* type, expanded subapically, narrowed basally; base itself shaped like a foot; with well-developed, subapical, three-pronged plume (PM.); two long paired apical bristles; posterior (ventral) margin with two shorter paired subapical bristles, four or five other very short submarginal bristles which may or may not be paired, most proximal of these about at mid-point of entire posterior margin. Membranous process (PR.) arising from base of eighth sternum, large and rounded posteriorly, with many rather long, thin spicules on ventral half. Tergal apodeme of segment 9 (T.AP.9) large, triangular, extending almost as far anteriorly as manubrium

(MB.), which is narrowly triangular, with blunt apex. Narrow apical portion of immovable process of clasper (P.; and fig. 29) beginning at level of insertion of two long acetabular bristles, two



FIGS. 29-32. Process and digitoid of clasper. 29. *Monopsyllus polumus*, new species. 30. *Monopsyllus eumolpi* (Rothschild, 1905). 31. *Monopsyllus fornacis* Jordan, 1937. 32. *Monopsyllus eutamiadis* Augustson, 1941.

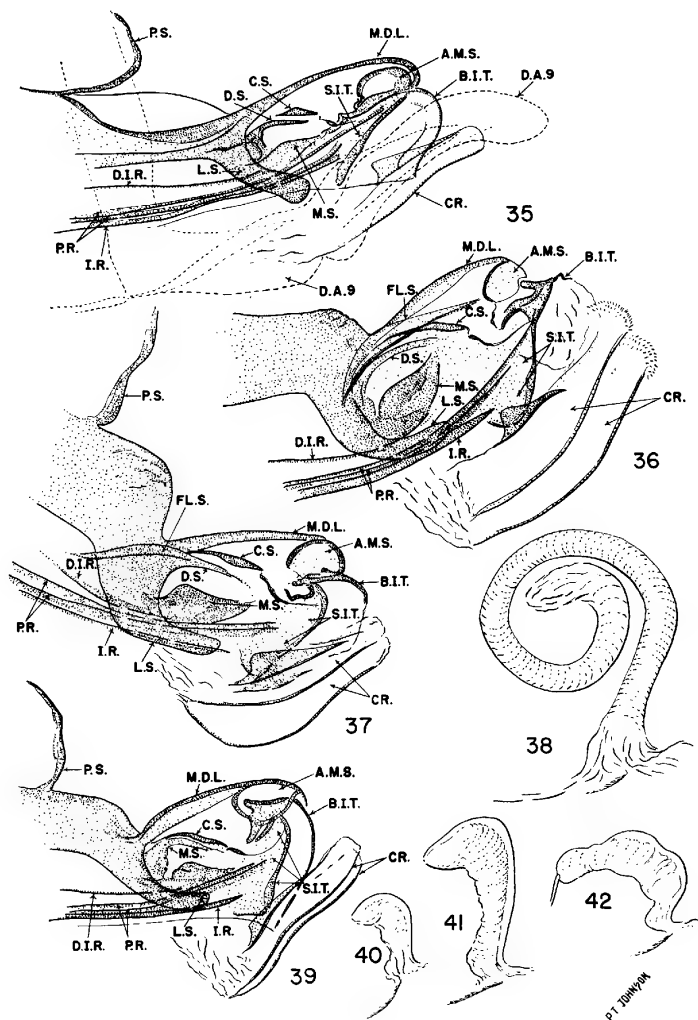
FIGS. 33, 34. *Monopsyllus polumus*, new species. 33. Modified abdominal segments, female. 34. Dorsal and ventral anal lobes.

times as high as broad; anterior and posterior margins slightly concave so that the middle is narrowest portion; apex rounded, bearing three bristles, middle one longest. Movable finger or

digitoid of clasper (F.; and fig. 29) with squared apex; anterior and posterior margins relatively straight, not parallel, so that digitoid broadens towards base; at level of large ventral spine, posterior margin angles anteriorly to insertion in P., this portion of margin also straight; dorsal margin with several small bristles; small bristles present on mesal and lateral surfaces roughly in median row from near base to near apex; rather heavy bristle at dorsocaudal angle; with three equidistant, dark, heavy spiniforms on posterior margin, upper spiniform just below dorsocaudal angle, one-third of length of lowest, mid-spiniform but slightly longer than upper, lowest as long as narrowed apical portion of P. Distal arm of sternum 9 (D.A.9; and fig. 45) with apical portion curved, apex rounded; a few small apical and subapical bristles; posterior margin with several small, thin, widely spaced bristles; below these a mediocaudal lobe bearing a close-set group of very thick bristles, followed by a deep incassation; below this narrow sinus a row of six or seven bristles, first two long, submarginal, others much shorter, marginal.

AEDEAGUS (FIGS. 27 AND 35): Aedeagal apodeme (AE.A) five times as long as broad; apical appendage (AP.A) very short; well-developed proximal spur (P.S.) at apical third. Median dorsal lobe (M.D.L.) evenly concave at juncture to aedeagal apodeme, not angled; with well-sclerotized, slightly convex, dorsal margin. Flanking sclerite (cf. figs. 36 and 37, FL.S.) not visible in holotype, may be missing in species. Apicomedian sclerite (A.M.S.) ovate to rounded, lightly sclerotized except for margins. Band of inner tube (B.I.T.) long and well sclerotized. Sclerotized inner tube (S.I.T.) relatively narrow (cf. figs. 36, 37, and 39), without distinct armature dorsally; ventral outline quite long, extending to level of median sclerite of apodemal strut (M.S.). Lateral sclerite of apodemal strut (L.S.) with slightly expanded apex. Crochets (CR.) elongate, extending beyond apex of aedeagus; with triangular thickening on dorsal margin; ventral margin not heavily sclerotized; apical third somewhat concave, then slightly convex to base, which is in vicinity of apodemal strut. Third aedeagal rod (A.A.R.) about same length as aedeagal apodeme; arising from ninth sternum at level of ventromedian sinus. Penis rods (P.R.) short, portion extending beyond apex of apodeme less than one-half of length of apodeme. Intramural rod (I.R.) and dorsal intramural rod (D.I.R.) fairly well sclerotized.

Dorsal anal lobe (fig. 27, D.A.L.) cone-shaped, with several apical and dorsal bristles; ventral anal lobe (fig. 27, V.A.L.) narrowed apically, with brush of heavy bristles on dorsal margin



FIGS. 35-37. Apical portion of aedeagus. 35. *Monopsyllus polumus*, new species. 36. *Monopsyllus eumolpi* (Rothschild, 1905). 37. *Monopsyllus fornacis* Jordan, 1937.

FIG. 38. *Monopsyllus eumolpi* (Rothschild, 1905). Bursa copulatrix.

FIG. 39. *Monopsyllus eutamiadis* Augustson, 1941. Apical portion of aedeagus.

FIGS. 40-42. Bursa copulatrix. 40. *Monopsyllus polumus*, new species. 41. *Monopsyllus fornacis* Jordan, 1937. 42. *Monopsyllus eutamiadis* Augustson, 1941.



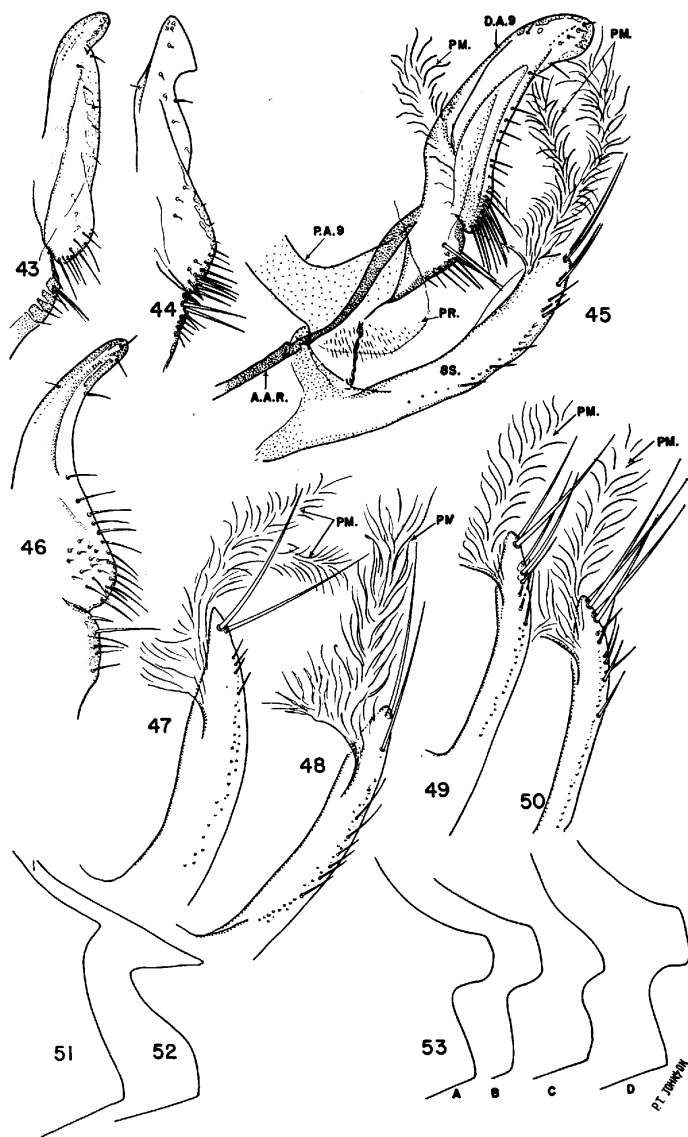
and apex; a membranous collar overlying base of the dorsal anal lobe.

MODIFIED ABDOMINAL SEGMENTS, FEMALE (FIG. 33): Posterior margin of seventh sternum (7S.) with lower portion slightly concave, the dorsal lobe of related species indicated only as a broad flattened prominence. Caudal margin of eighth tergum (8T.) with angle at level of anal lobes; above spiracle a patch of about 14 small bristles; below and posterior to spiracle, two long bristles; caudal margin ventrally from level of anal lobes with about five marginal bristles, two mesal bristles, and patch of 13 or 14 various-sized lateral and submarginal bristles. Anal stylet (A.S.; and fig. 34) two times as long as broad; bearing one long apical, one dorsomarginal, and one ventromarginal bristle. Ventral anal lobe (V.A.L.; and fig. 34) with five or six very broad, leaf-like bristles (typical of genus) at ventrocaudal angle. Ninth tergum (9T.) large, extending ventrally to level of bursal opening. Ninth sternum (9S.) bearing four small, paired, caudomarginal bristles. Bursa copulatrix (B.C.; and fig. 40) small; shaped like a vertebrate embryo; dorsocaudal margin thick. Spermatheca (S.P.; and fig. 22) with barrel-shaped body, tail not so long as body and one-half of its width, strongly curved.

#### COMMENT ON THE *EUMOLPI* GROUP

The members of the *eumolpi* group of *Monopsyllus* include those forms in which the digitoid of the male clasper bears three heavy spines on the posterior margin, the male eighth sternum has a well-developed, apical, three-pronged plume, and the body of the female spermatheca is barrel-shaped, with the tail narrower and shorter than the body. Their normal hosts are western chipmunks (genus *Eutamias*) and probably, for some species, pine squirrels or chickarees (genus *Tamiasciurus*).

Included in this complex are eight named forms: *Monopsyllus eumolpi*, consisting of six described subspecies, *M. fornacis* Jordan, 1937, and *M. eutamiadis* Augustson, 1941. *Monopsyllus polumus*, new species, is the ninth. In recent years there has been some question as to the taxonomic status of some members of the group. Thus Hubbard (1947, p. 242) maintained that *eutamiadis* is probably a Sierra Nevada mountain variation of *fornacis*, while Augustson stated in the original description of *eutamiadis* that it was closely related to, and possibly a subspecies of, *eumolpi*. It is not within the scope of this paper to define the various sub-



FIGS. 43, 44. Distal arm of ninth sternum. 43. *Monopsyllus fornacis* Jordan, 1937. 44. *Monopsyllus eumolpi* (Rothschild, 1905).

FIG. 45. *Monopsyllus polumus*, new species. Distal arm of ninth sternum and eighth sternum.

FIG. 46. *Monopsyllus eutamiadis* Augustson, 1941. Distal arm of ninth sternum.

FIGS. 47-50. Eighth sternum. 47. *Monopsyllus fornacis* Jordan, 1937. 48. *Monopsyllus eutamiadis* Augustson, 1941. 49, 50. *Monopsyllus eumolpi* (Rothschild, 1905), showing variations.

FIGS. 51-53. Seventh sternum, female. 51. *Monopsyllus fornacis* Jordan, 1937. 52. *Monopsyllus eutamiadis* Augustson, 1941. 53A-D. *Monopsyllus eumolpi* (Rothschild, 1905), showing variations.

species of *eumolpi*, but a redefinition of the various species is pertinent. Specimens of *eumolpi* corresponding to the original description and figures of the parent subspecies *e. eumolpi* only have been drawn for comparative purposes.

The *eumolpi* complex can be divided into two groups, based on the length of the apical appendage of the aedeagal apodeme in the male and the shape of the bursa copulatrix in the female. *Monopsyllus polumus*, *M. fornacis*, and *M. eutamiadis* have in common a short apical appendage (fig. 27, AP.A.) and a non-coiled bursa copulatrix (figs. 40, 41, and 42), whereas *M. eumolpi*, *sensu lato*, has a long apical appendage (fig. 28, AP.A.) and a coiled bursa copulatrix (fig. 38).

*Monopsyllus eutamiadis* and *M. fornacis* are further separable from *eumolpi* in that the band of the inner tube (figs. 37, 39, B.I.T.) is longer than in *eumolpi* (fig. 36, B.I.T.); by the shape and chaetotaxy of the distal arm of the ninth sternum (cf. figs. 43, 44, and 46) and the eighth sternum (cf. figs. 47, 48, 49, and 50); as well as the shape of F. and P. (cf. figs. 30, 31, and 32); and in the female by the shape of the posterior margin of the seventh sternum (figs. 51, 52, 53A, B, C, and D).

*Monopsyllus eutamiadis* differs from *M. fornacis* in several constant characters. The juncture of the aedeagal apodeme and the median dorsal lobe of the aedeagus is much deeper in *fornacis* (fig. 37) than in *eutamiadis* (fig. 39); the flanking sclerite (FL.S.) is well developed and extends over the apodemal strut in *fornacis* (fig. 37) but was not apparent in specimens of *eutamiadis* examined; the eighth sterna (figs. 43, 46) are of two distinct types. In the female, the posterior margins of the seventh sterna are quite different (figs. 51, 52). These distinctions are considered by us to be at the species level. *M. eutamiadis* differs from *M. polumus* in shape of various sclerites of the aedeagus (figs. 35, 39); the eighth sternum (figs. 45, 48); distal arm of the ninth sternum (figs. 45, 46); and outline of the posterior margin of the seventh sternum of the female (figs. 33, 52). In addition to these characters, the eighth tergum of male *eutamiadis* bears at least 16 dorso-marginal and mediolateral bristles on its upper half (fig. 24); *polumus* has but four or five (fig. 27, 8T.).

#### ACKNOWLEDGMENTS

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